SERMA TECHNOLOGIES

FAILURE ANALYSIS
ON DIODES WITH BLACK AREA ON LEAD
REPORT E02P1638 – NOVEMBER 12, 2002

This analysis was performed for :

CEA
Bâtiment 534 – DAPNIA / SEDI
91191 GIF-SUR-YVETTE

Performed by : V. GUILMARD *Approved by* : D. TRIAS

Siège Social
30, avenue Gustave Eiffel
33608 PESSAC Cedex (France)
Tél : (33) 05.57.26.08.88 - Fax : (33) 05.57.26.08.98 – http : //www.serma.com
S.A. à Directoire et Conseil de Surveillance au capital de 2 301 072 € - SIRET 380 712 828 00058 – CODE APE 731 Z

INTRODUCTION

Two diodes (S/N 325 and S/N 367) were submitted to Serma Technologies for failure analysis.

These diodes showed the presence of black areas located on one lead.

CONCLUSION

* The analysis has revealed that the presence of the black area on lead was due to an oxidation of the lead material (FeNi).

* This oxidation was probably induced by the presence of contamination at the lead surface before the NiP layer deposit process which has been trapped between the lead material (FeNi) and the NiP coating.

ANALYSIS PROCESS

- Analysis process was the following :
  - optical visual inspection
  - SEM inspection and material analysis at surface
  - crossection

RESULTS

OPTICAL AND SEM INSPECTION

- The leads were inspected under binocular and SEM.
- A large dark area was observed at one lead on each sample (Figure 2).
- On dark area, the material analysis showed the presence of iron, nickel, oxygen, carbon, and phosphorous (Figures 3 and 4). The lead was oxidized.

CROSSECTION

- We observed at dark area level a large oxidation of the NiP layer and of the lead material (FeNi) (Figures 5 and 6).

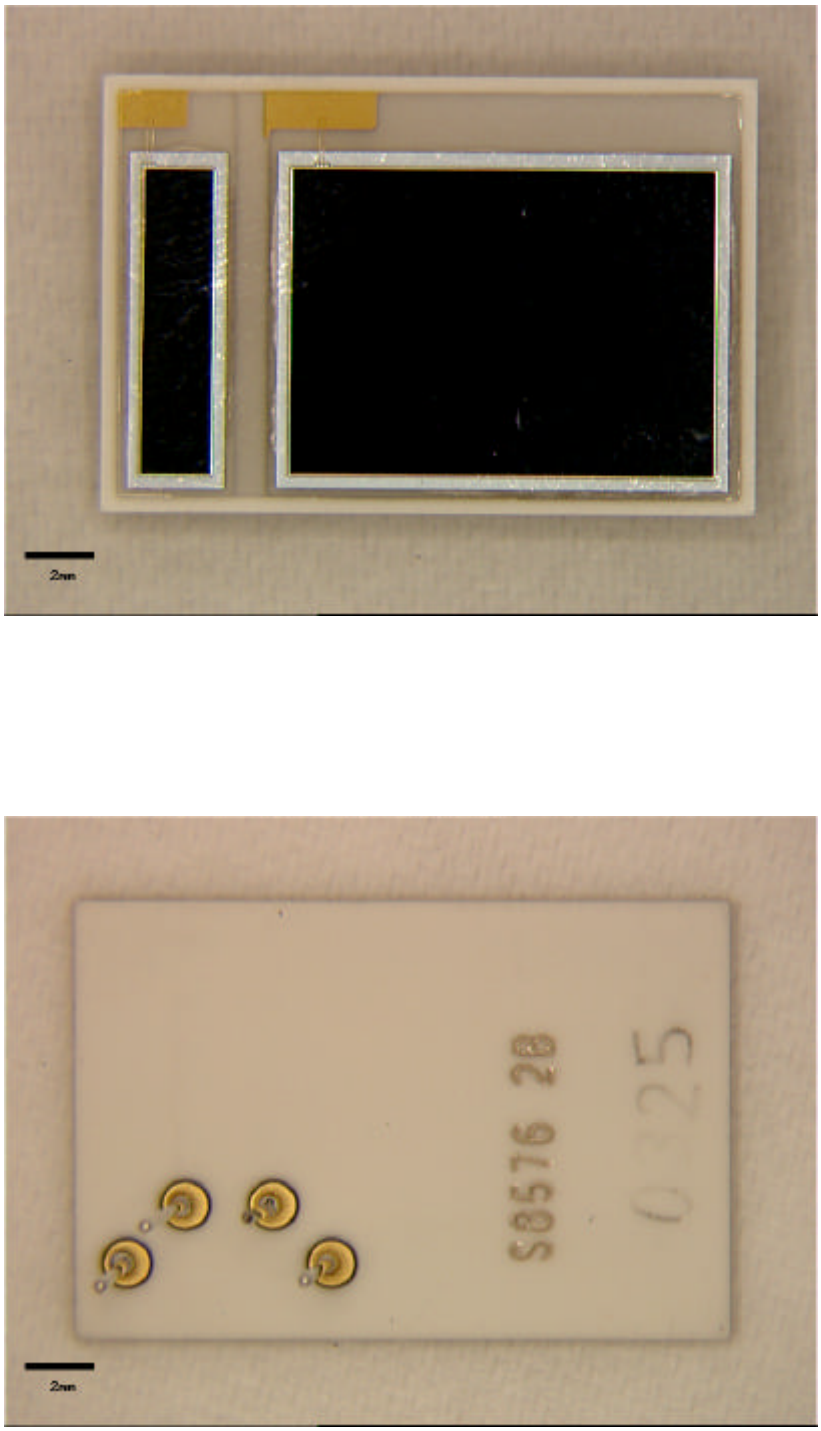
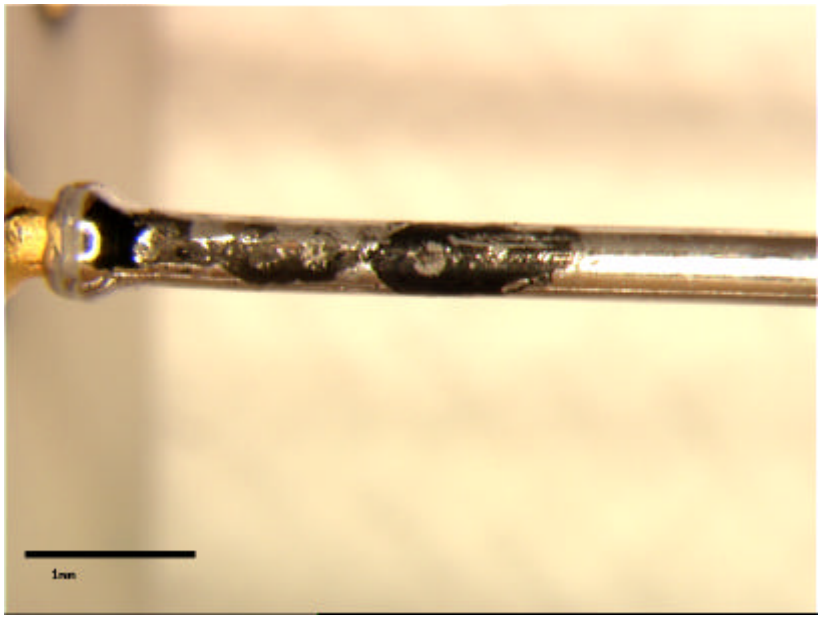
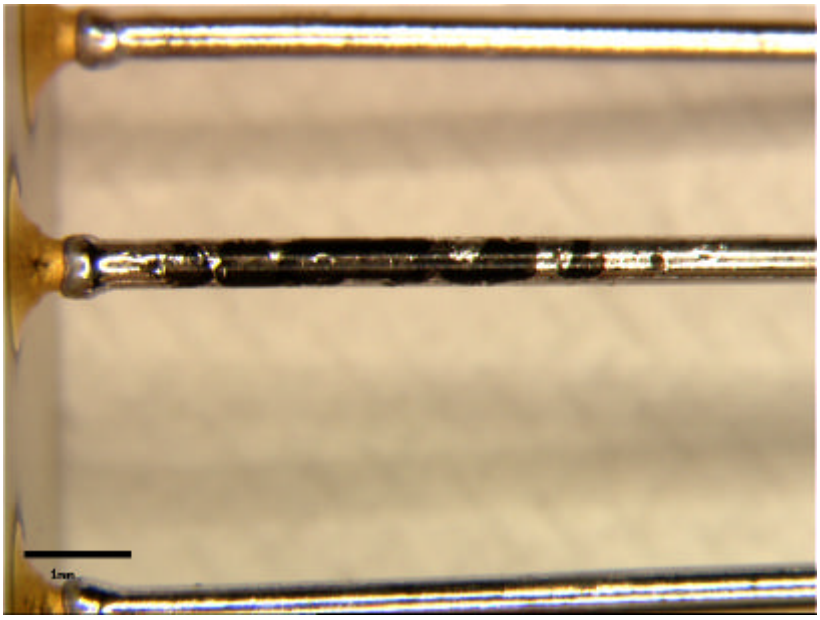


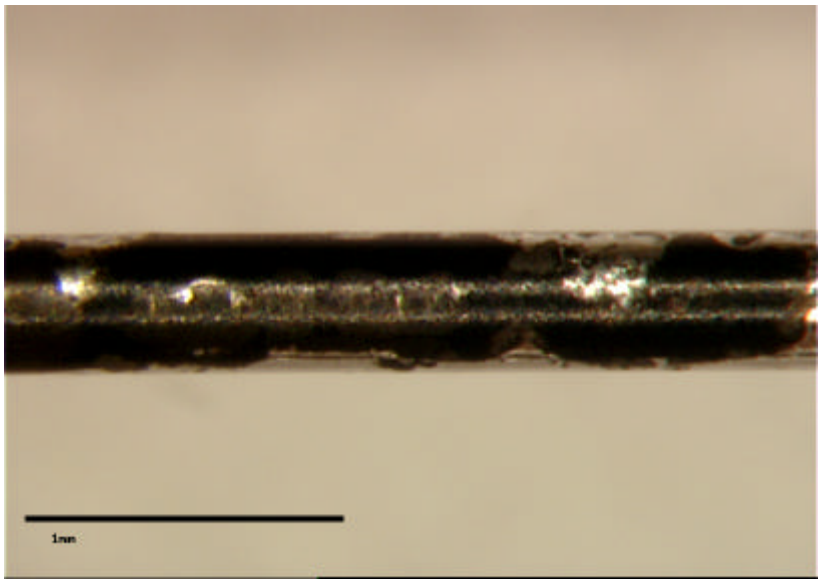
Figure 1. General views of one diode, S/N 325, mag ≈4X.



S/N 325



S/N 367



S/N 367

Figure 2. Detailed optical views of dark area on lead.
Top : mag ≈25X ; center : mag ≈17X ; bottom : mag ≈45X.

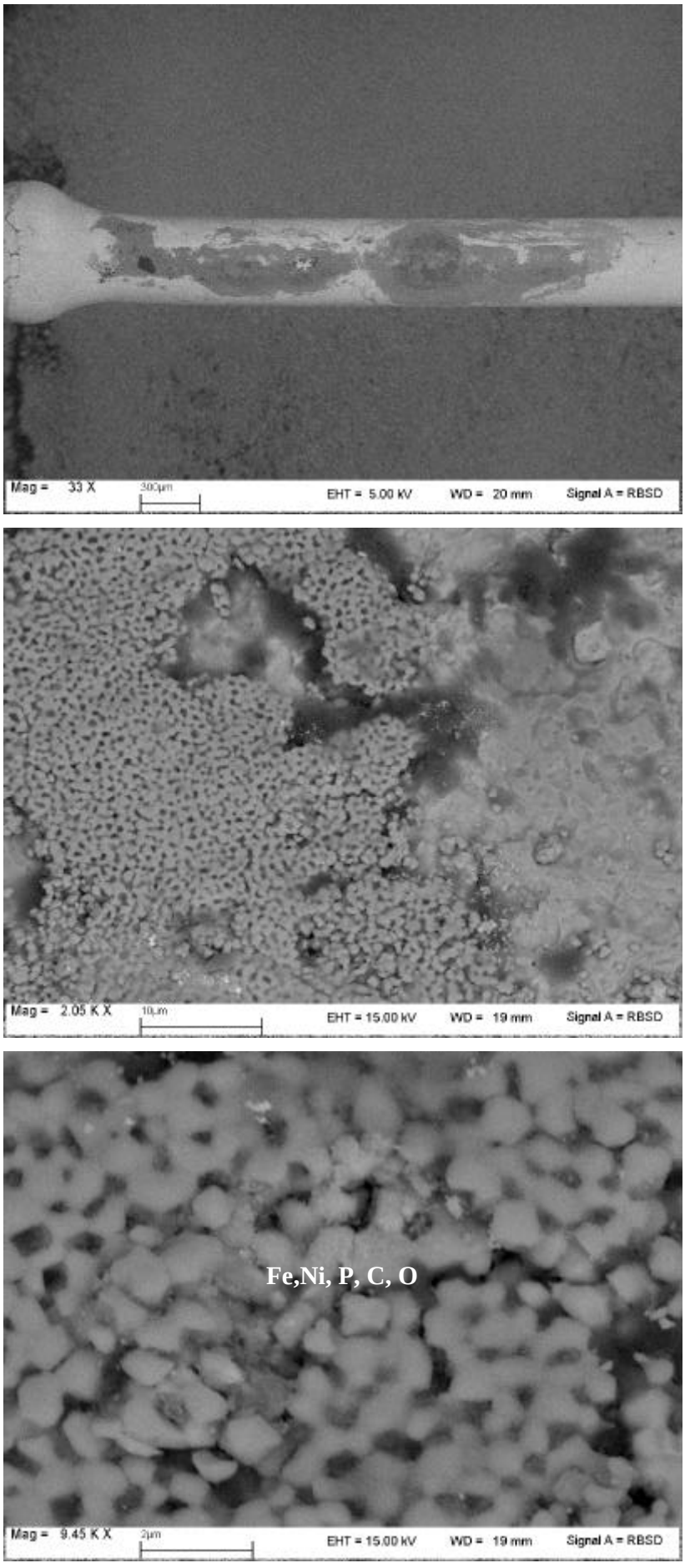


Figure 3. General and detailed SEM views of dark area on lead, S/N 325.
Top : mag 33X ; center : mag 2050X ; bottom : mag 9450X.

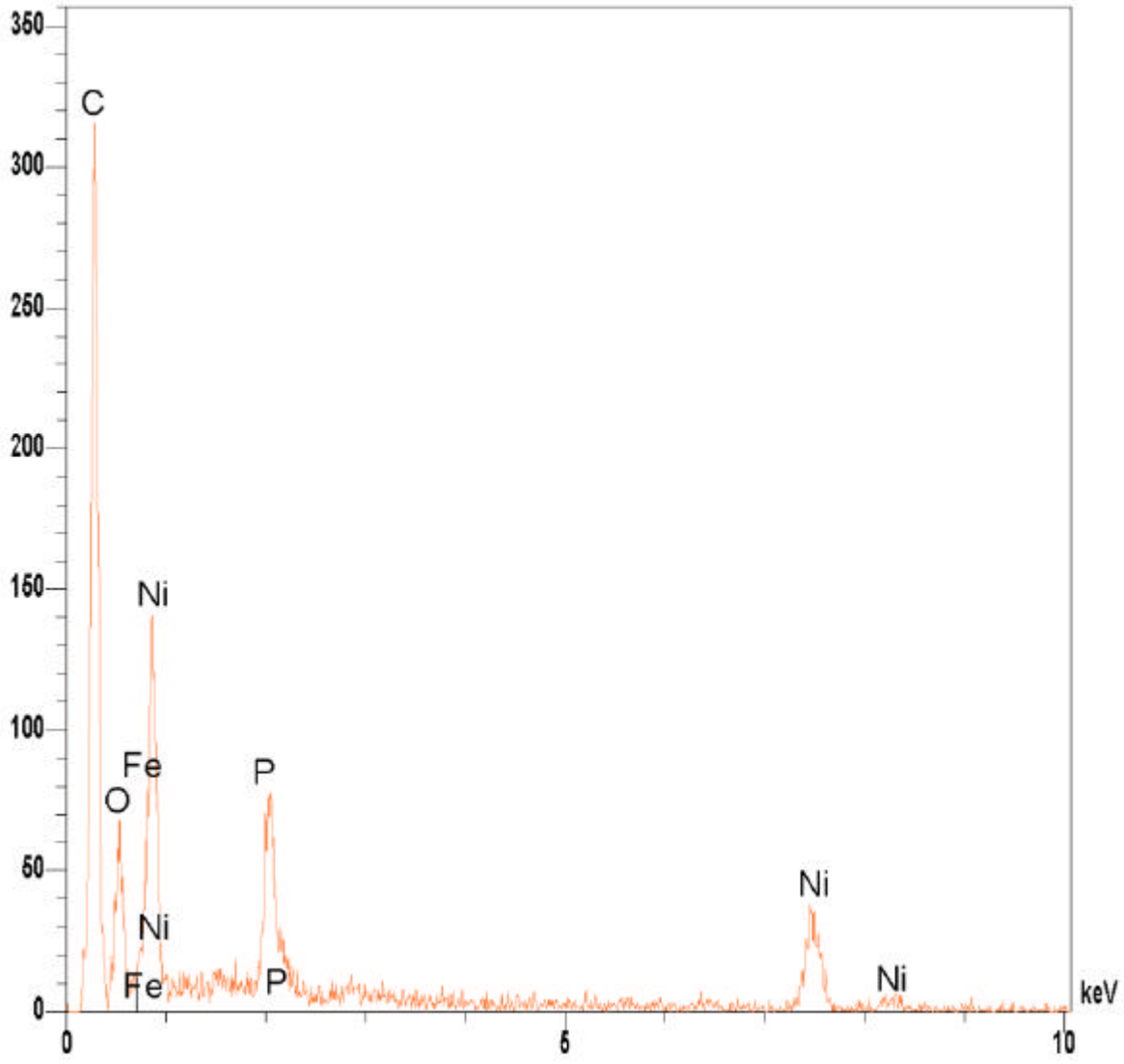


Figure 4. EDX analysis spectrum on black area.

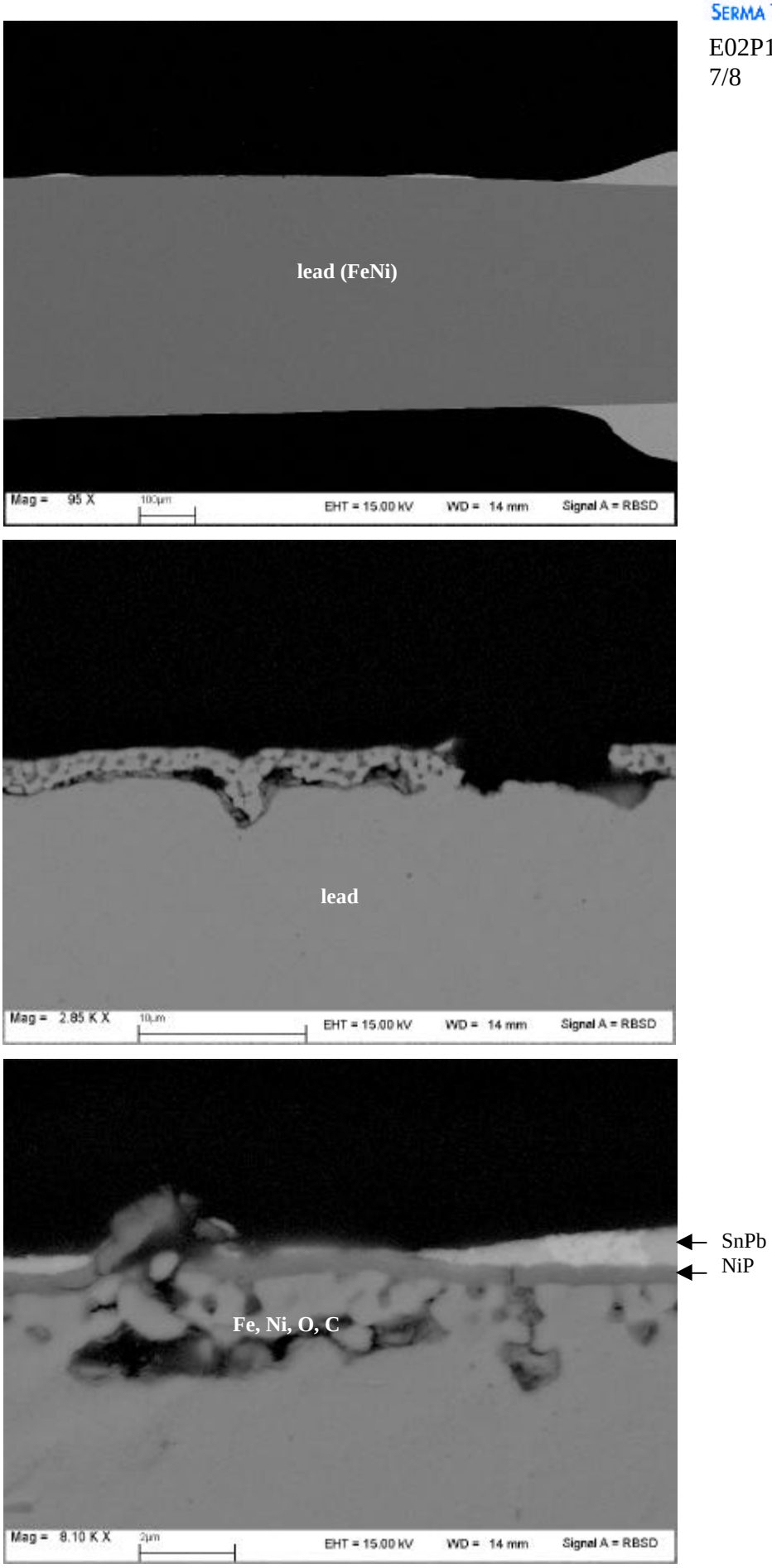


Figure 5. SEM views in section of dark area on lead, S/N 367.
Top : mag 95X ; center : mag 2850X ; bottom : mag 8100X.

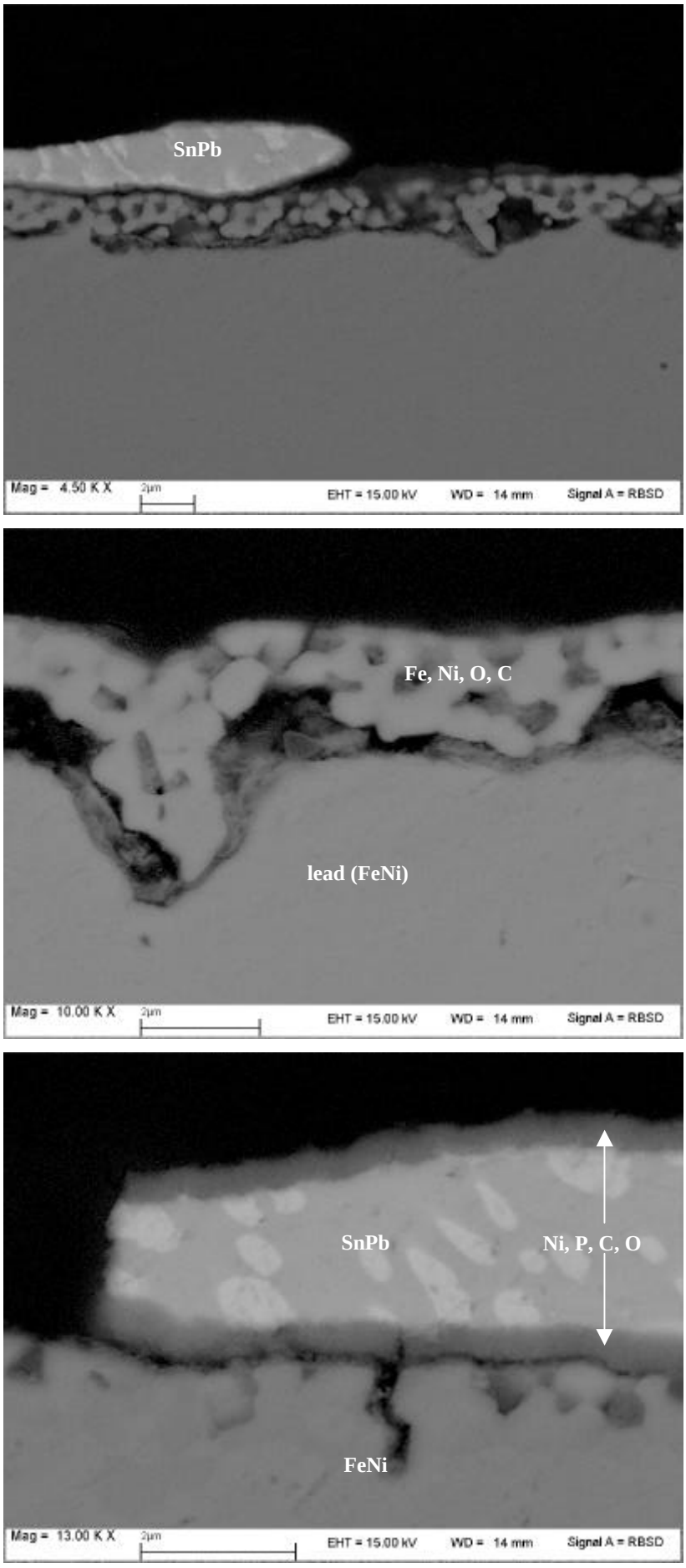


Figure 6. SEM views in section of dark area on lead, S/N 367.
Top : mag 4500X ; center : mag 10000X ; bottom : mag 13000X.